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Yeap et al.

(10) **Patent No.: US 9,971,986 B2**
(45) **Date of Patent: May 15, 2018**

(54) **METHOD AND SYSTEM FOR VALIDATING A DEVICE THAT USES A DYNAMIC IDENTIFIER**

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(73) Assignee: **BCE INC.**, Verdun (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 892 days.

(21) Appl. No.: **13/852,352**

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(51) **Int. Cl.**
G06Q 10/08 (2012.01)
G06F 21/43 (2013.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G06Q 10/087*** (2013.01); ***G06F 9/445*** (2013.01); ***G06F 21/43*** (2013.01); ***G06F 21/79*** (2013.01);
(Continued)

(58) **Field of Classification Search**
USPC 726/2, 4, 5, 9, 10, 27, 30; 705/64, 65, 705/67; 235/375, 382, 382.5
See application file for complete search history.

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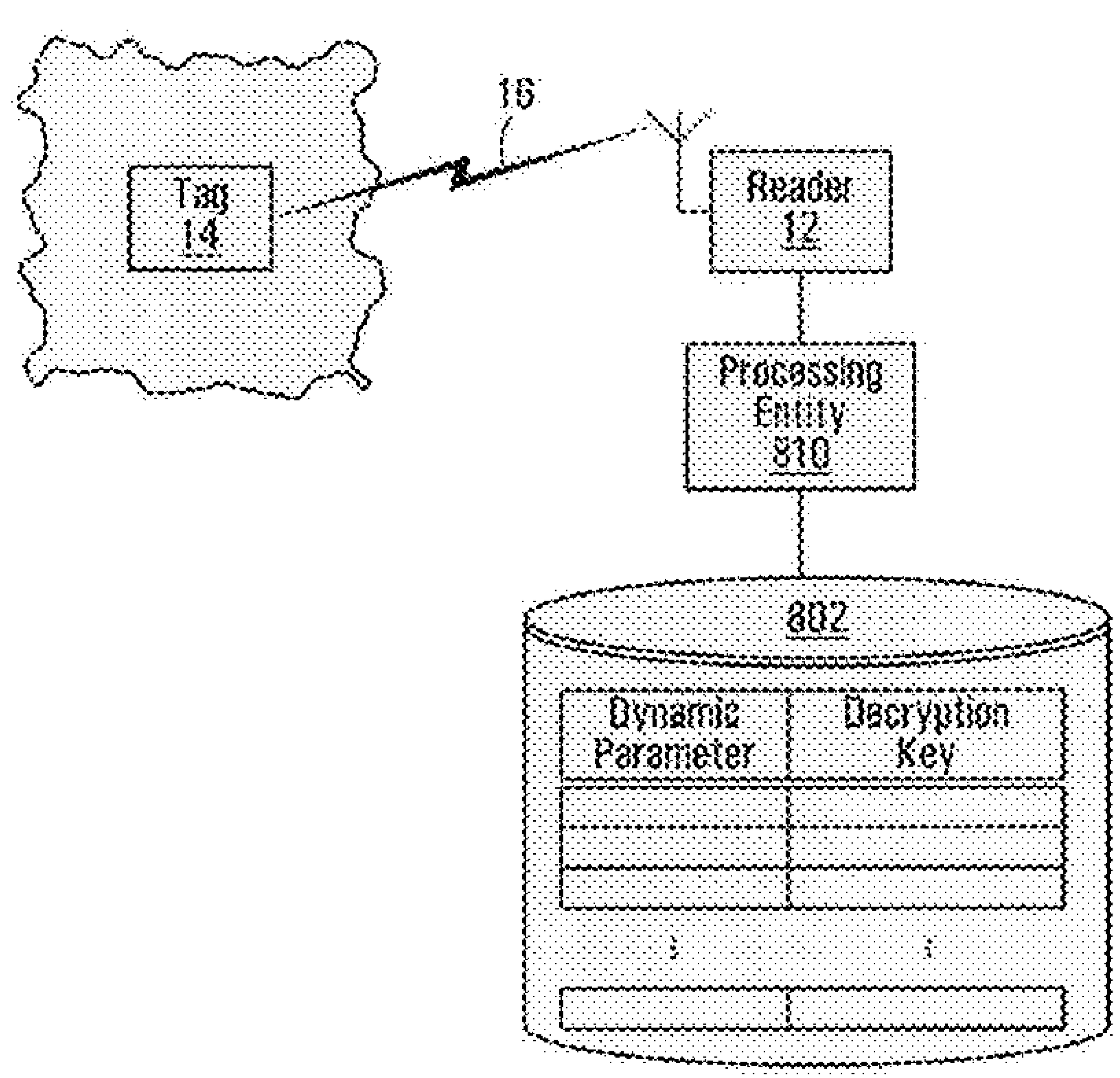
U.S. Appl. No. 13/852,352, Yeap et al., Mamon Obeid.*
(Continued)

Primary Examiner — Mamon Obeid

(57) **ABSTRACT**

A method that comprises obtaining a currently received signature from a device; obtaining a candidate identifier associated with the device; consulting a database to obtain a set of previously received signatures associated with the candidate identifier; and validating the currently received signature based on a comparison of the currently received signature to the set of previously received signatures associated with the candidate identifier. Also, a method that comprises obtaining a currently received signature from a device; decrypting the currently received signature to obtain a candidate identifier; and a candidate scrambling code; consulting a database to obtain a set of previously received scrambling codes associated with the candidate identifier; and validating the currently received signature based on a comparison of the candidate scrambling code to the set of previously received scrambling codes associated with the candidate identifier.

35 Claims, 12 Drawing Sheets



Related U.S. Application Data

continuation-in-part of application No. PCT/CA2007/002343, filed on Dec. 20, 2007.

(51) **Int. Cl.**

G06F 21/79	(2013.01)
G06Q 20/02	(2012.01)
G06Q 20/34	(2012.01)
G06Q 20/38	(2012.01)
G06Q 20/40	(2012.01)
G06Q 20/42	(2012.01)
G07F 7/10	(2006.01)
H04L 29/06	(2006.01)
H04L 9/32	(2006.01)
G06F 9/445	(2018.01)
H04W 12/10	(2009.01)
H04W 12/08	(2009.01)

(52) **U.S. Cl.**

CPC ***G06Q 20/02*** (2013.01); ***G06Q 20/341*** (2013.01); ***G06Q 20/385*** (2013.01); ***G06Q 20/3825*** (2013.01); ***G06Q 20/3829*** (2013.01); ***G06Q 20/40*** (2013.01); ***G06Q 20/401*** (2013.01); ***G06Q 20/40975*** (2013.01); ***G06Q 20/425*** (2013.01); ***G07F 7/1008*** (2013.01); ***H04L 9/3247*** (2013.01); ***H04L 63/0823*** (2013.01); ***H04L 63/0846*** (2013.01); ***H04L 63/126*** (2013.01); ***H04W 12/08*** (2013.01); ***H04W 12/10*** (2013.01); *H04L 2209/56* (2013.01); *H04L 2209/805* (2013.01); *H04L 2209/84* (2013.01)

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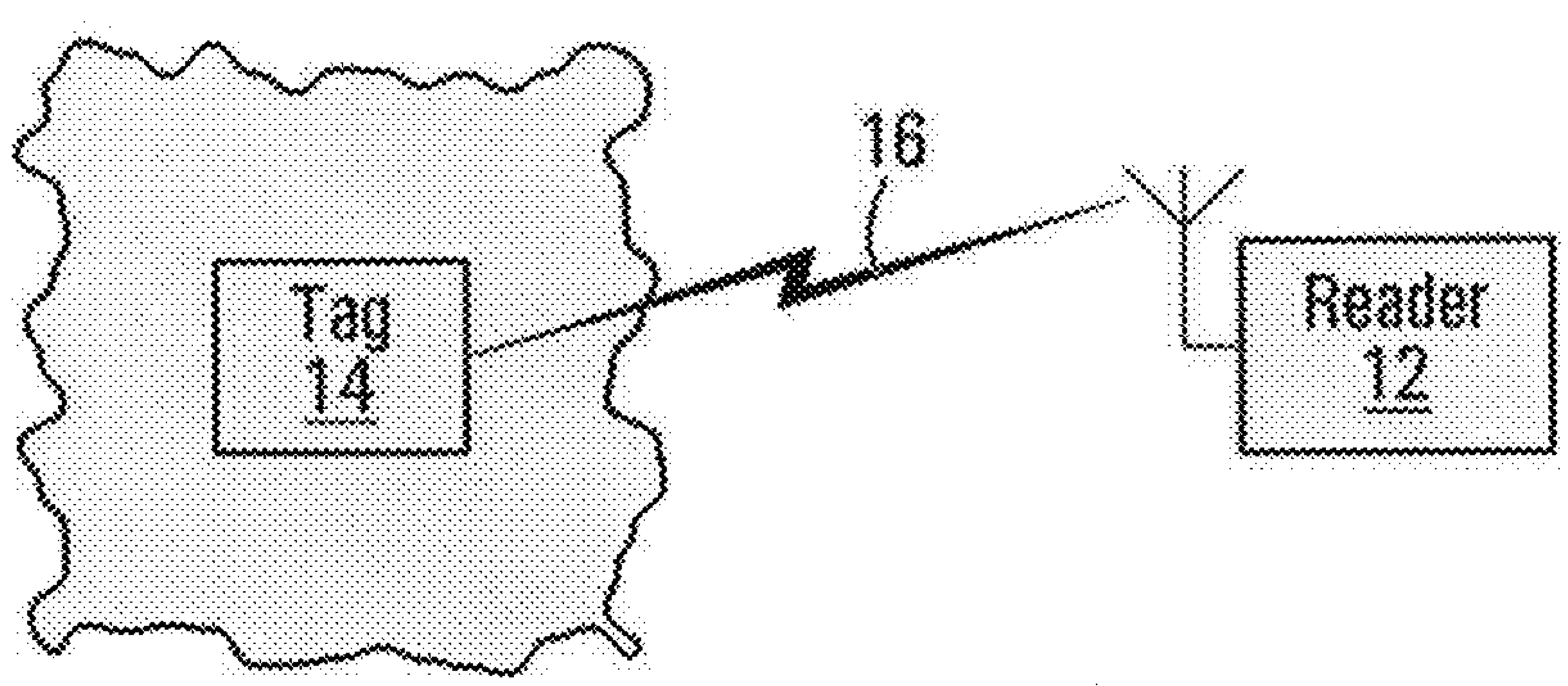

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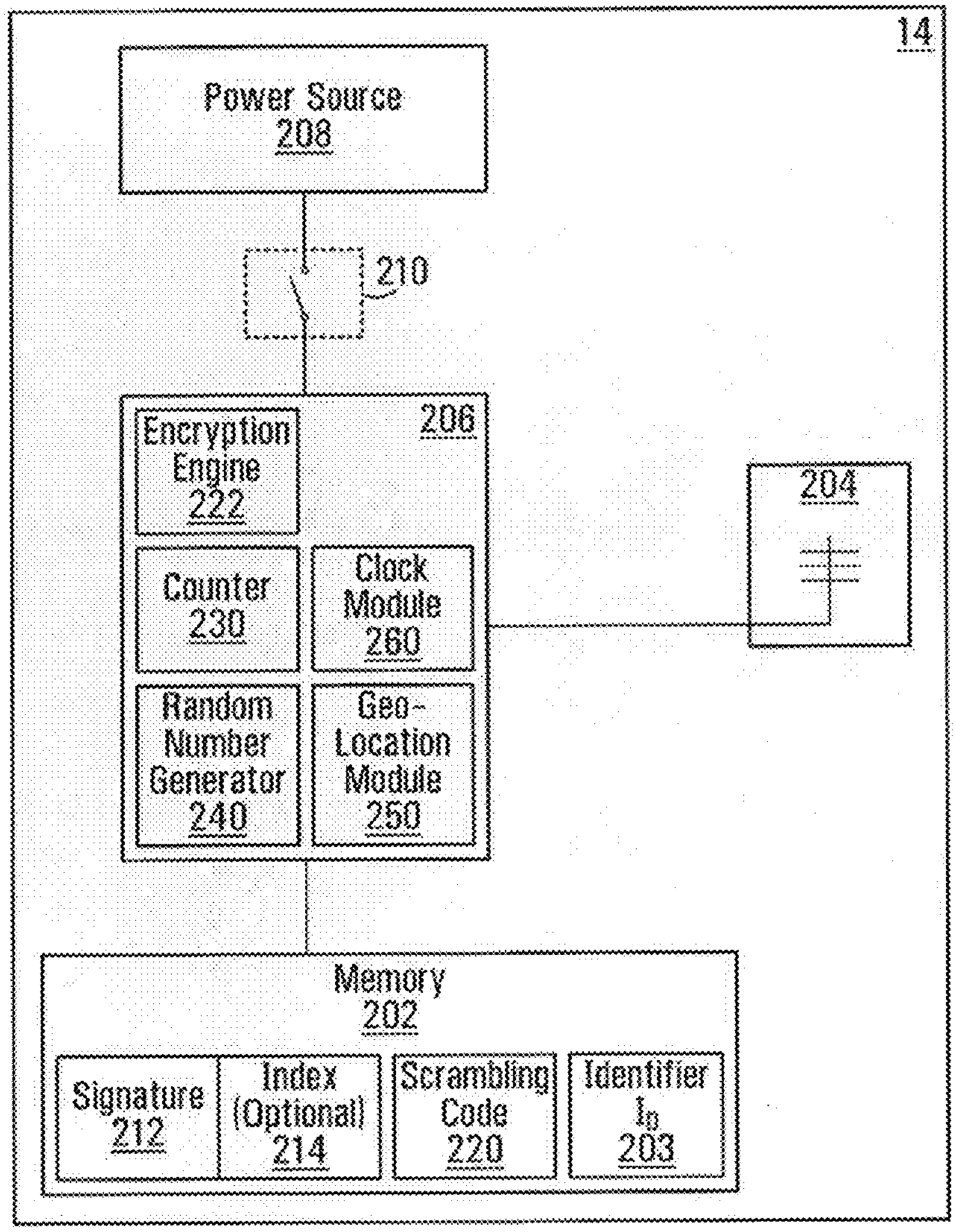

14
Power Source
208
210
206
Encryption Engine
222
Counter
230
Clock Module
260
Random Number Generator
240
Geo-Location Module
250
204
Memory
202
Signature
212
Index (Optional)
214
Scrambling Code
220
Identifier
I_D
203

FIG. 2

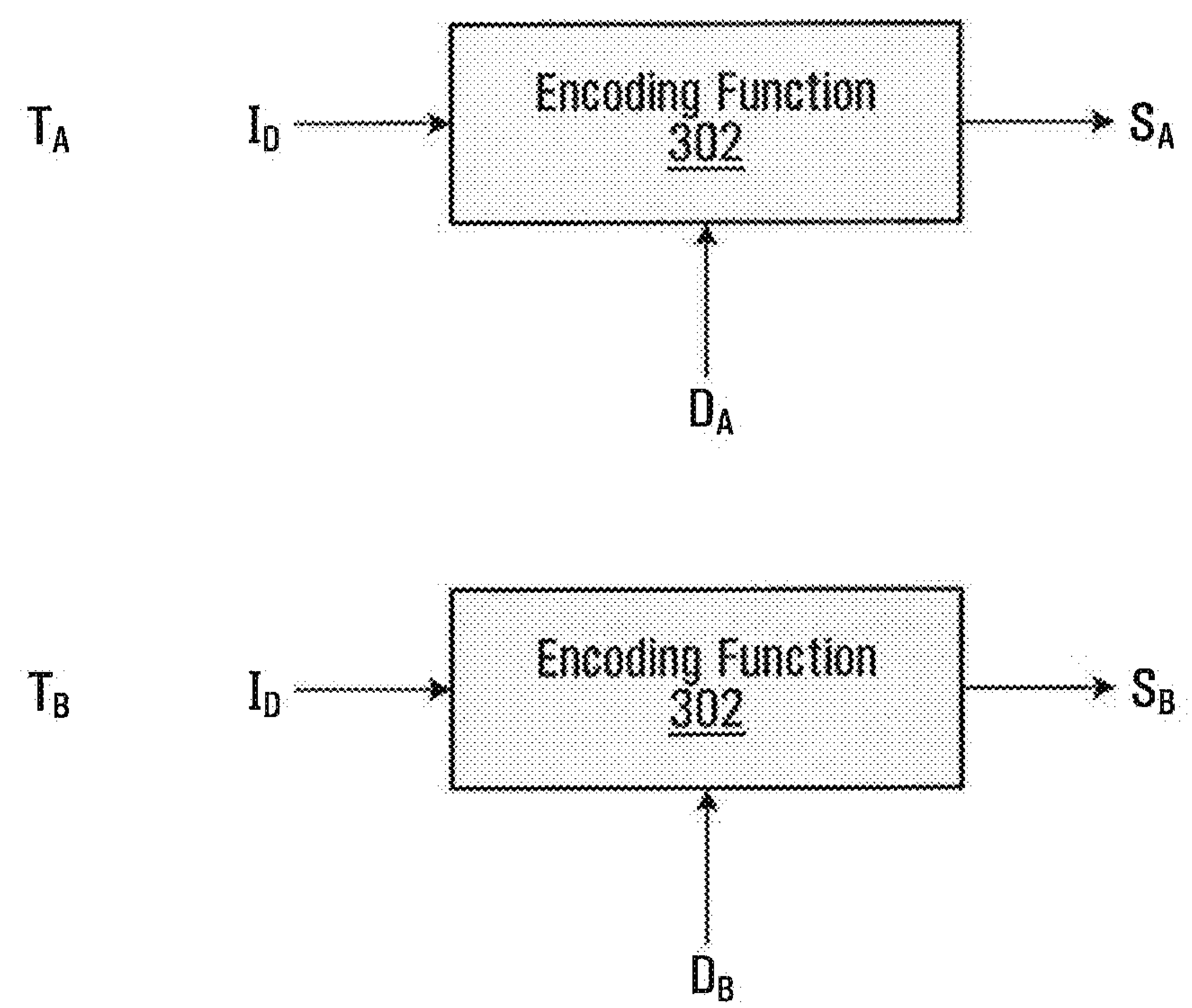

TA
ID
Encoding Function
302
SA
DA
TB
ID
Encoding Function
302
SB
DB

FIG. 3

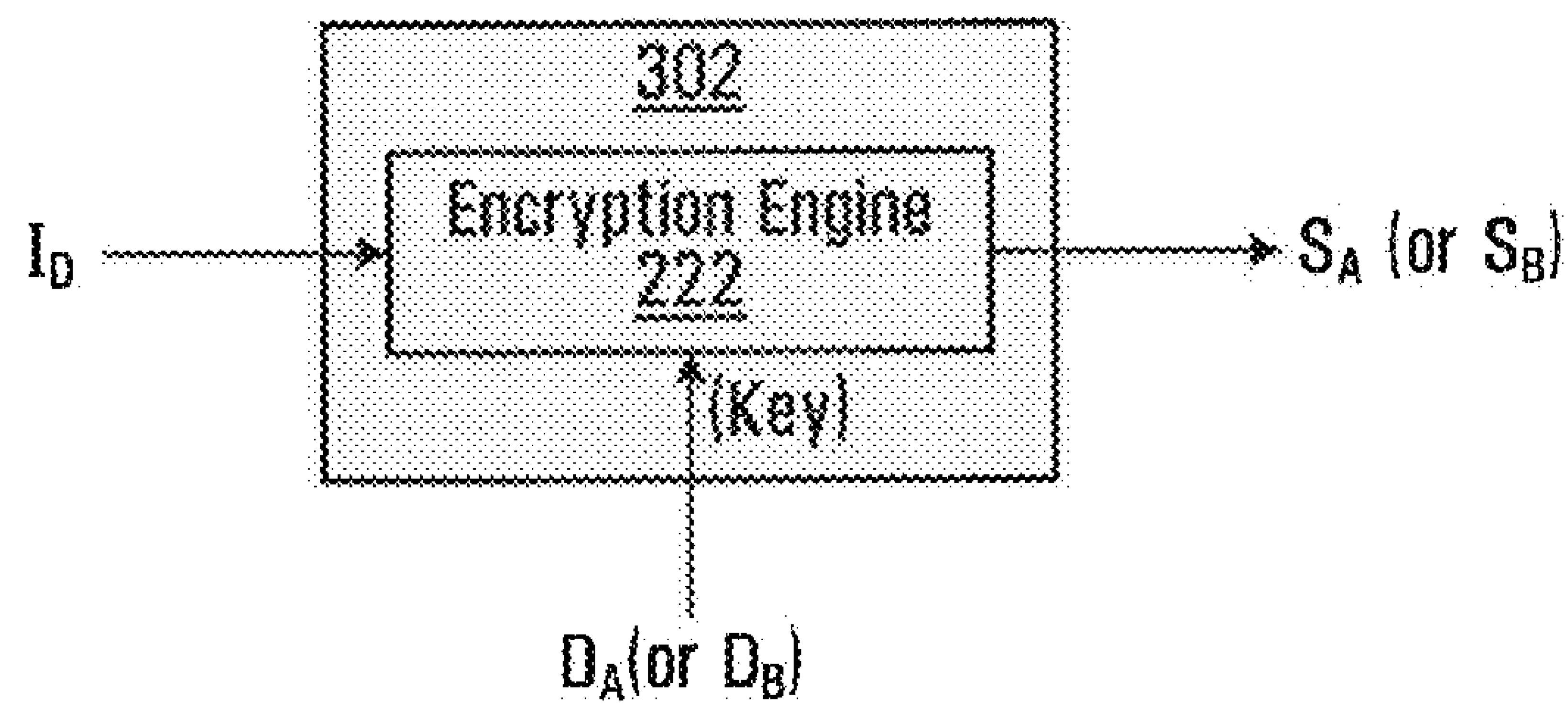

302
Encryption Engine
222
I_D
S_A (or S_B)
(Key)
D_A(or D_B)

FIG. 4A

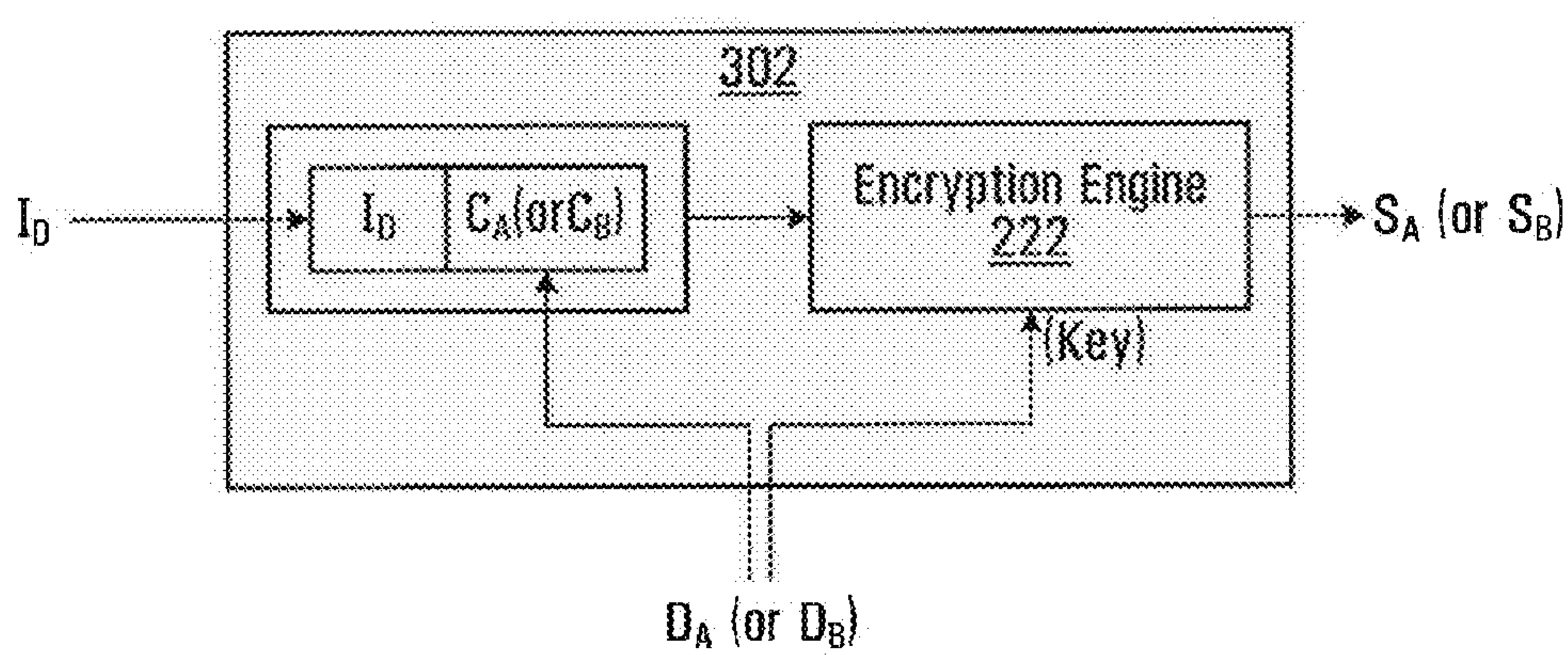

302
I_D
I_D
C_A(orC_B)
Encryption Engine
222
S_A (or S_B)
(Key)
D_A (or D_B)

FIG. 4B

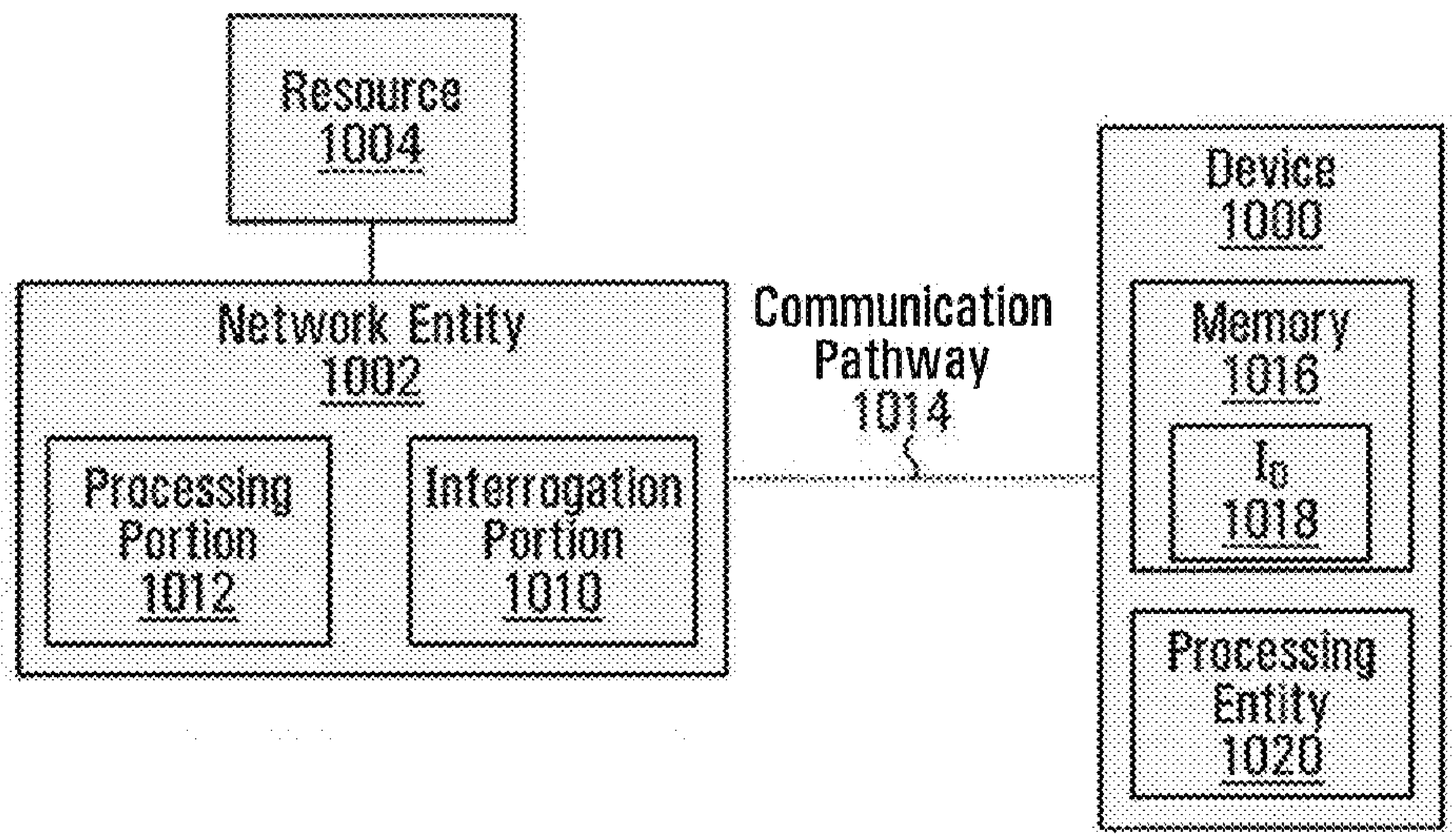
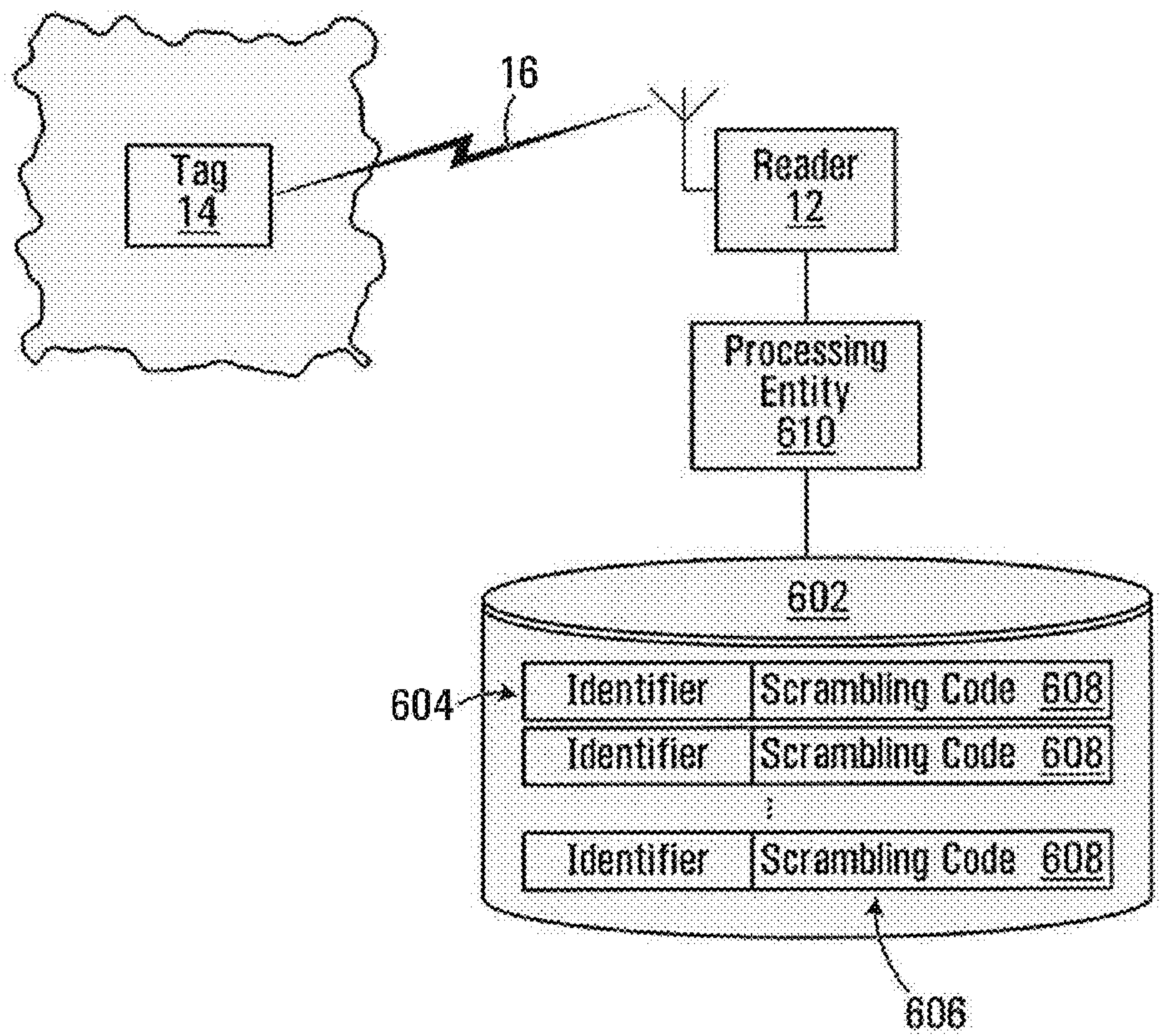

Resource
1004
Network Entity
1002
Processing
Portion
1012
Interrogation
Portion
1010
Communication
Pathway
1014
Device
1000
Memory
1016
I_0
1018
Processing
Entity
1020

FIG. 5



16
Tag
14
Reader
12
Processing
Entity
610
602
604
Identifier
Scrambling Code 608
Identifier
Scrambling Code 608
Identifier
Scrambling Code 608
606

FIG. 6A

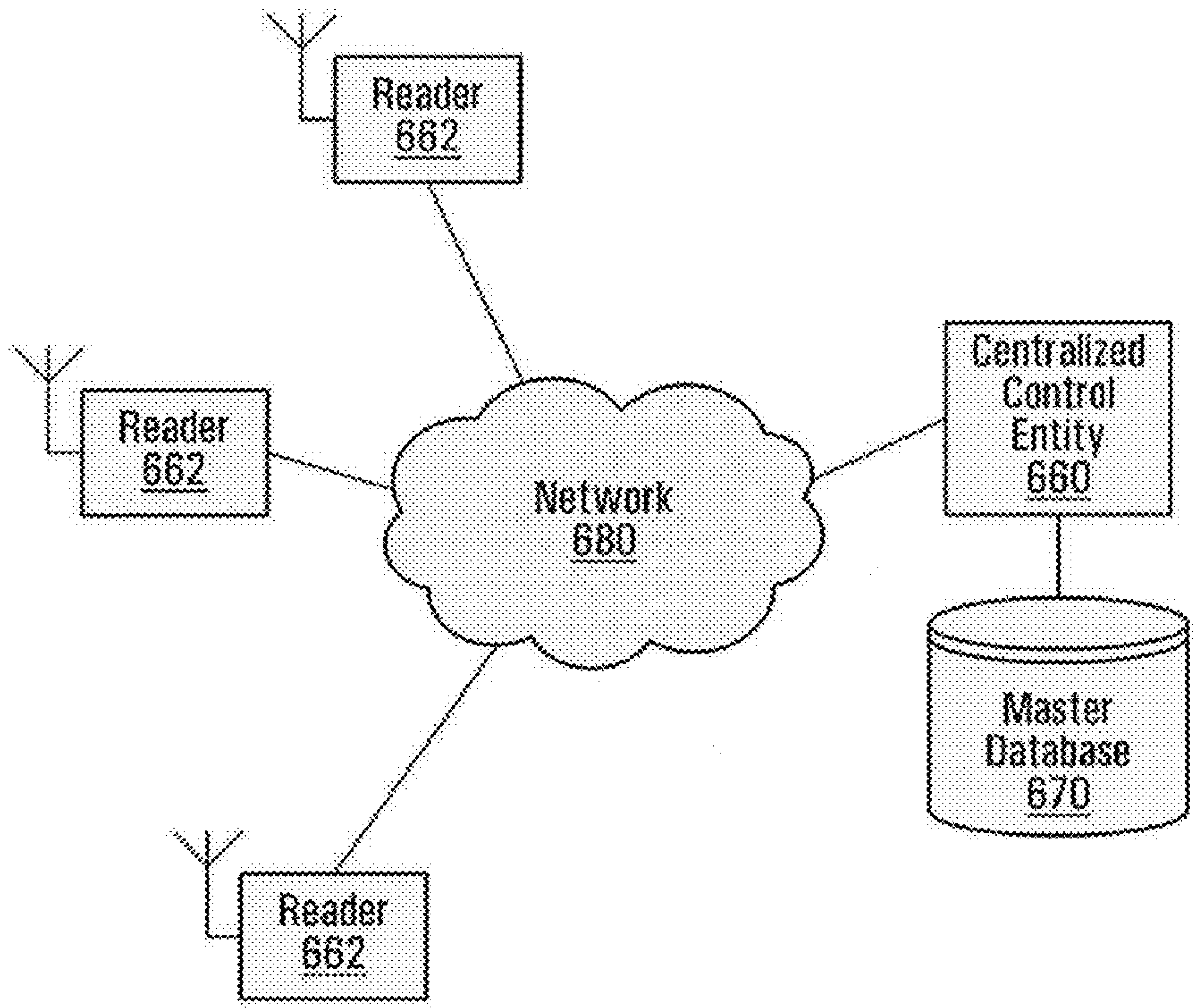

Reader
662
Reader
662
Reader
662
Network
680
Centralized
Control
Entity
660
Master
Database
670

FIG. 6B

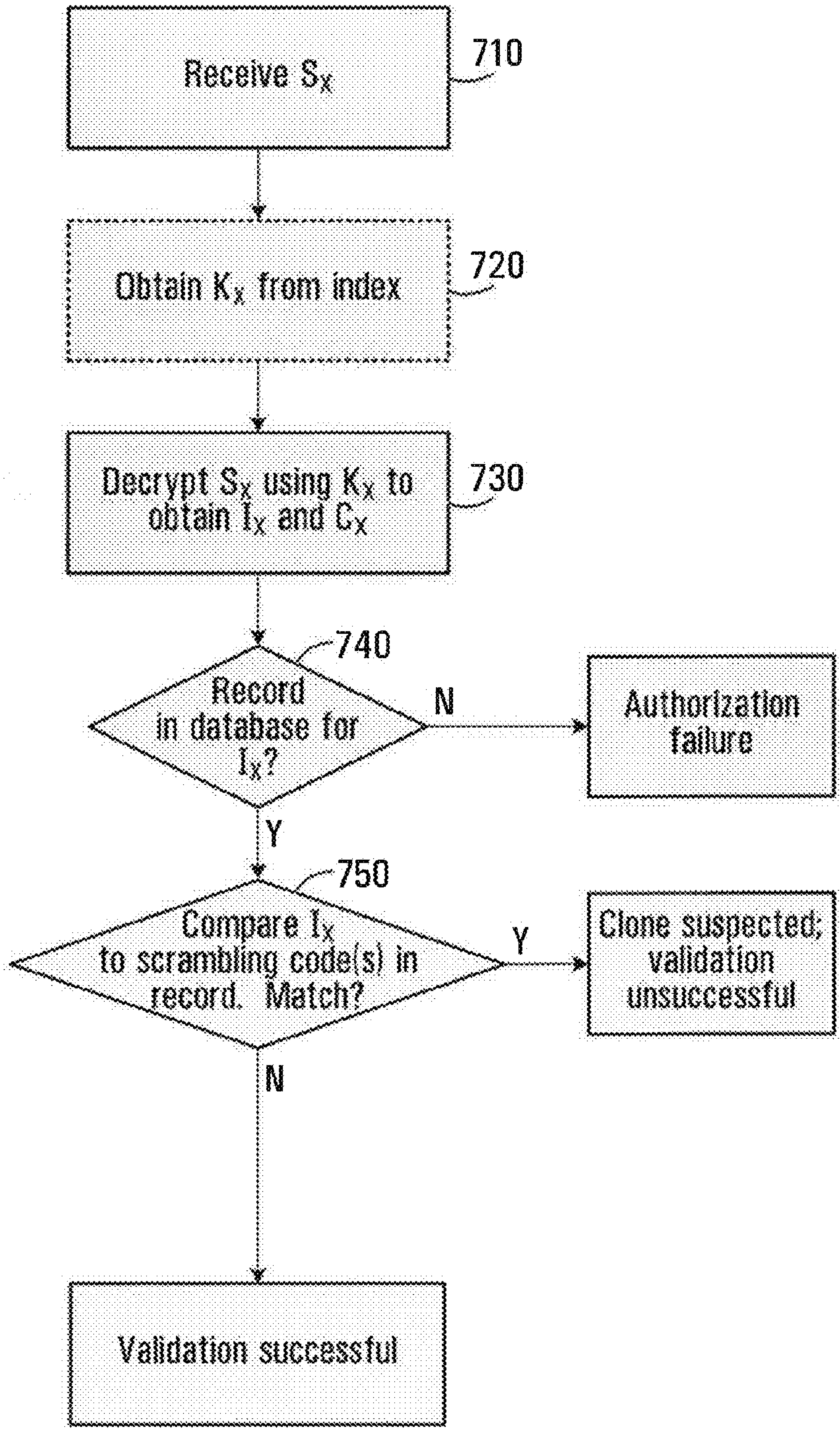
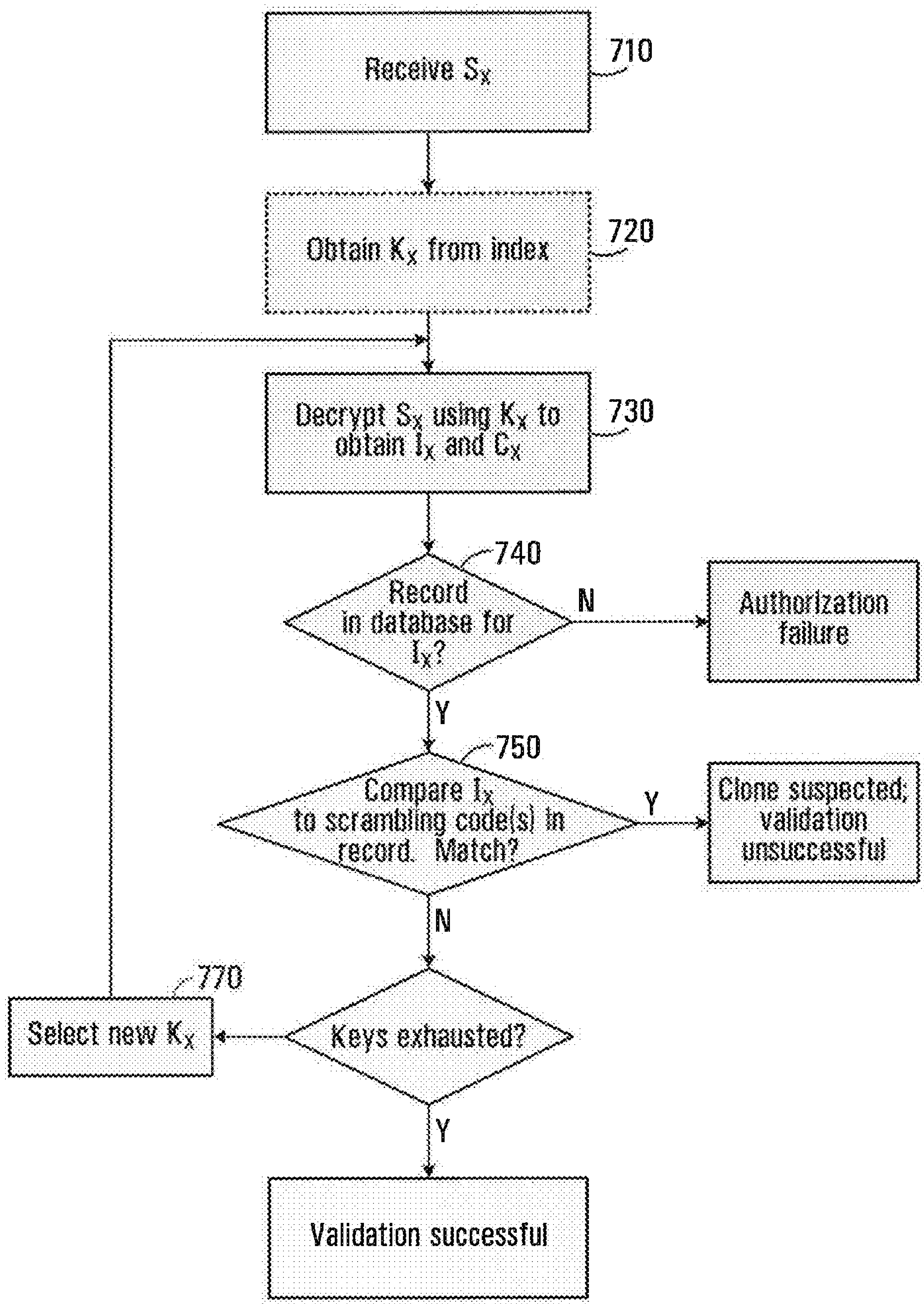

Receive S_x
710
Obtain K_x from index
720
Decrypt S_x using K_x to obtain I_x and C_x
730
740
Record in database for I_x?
N
Authorization failure
Y
750
Compare I_x to scrambling code(s) in record. Match?
Y
Clone suspected; validation unsuccessful
N
Validation successful

FIG. 7A



Receive Sx
710
Obtain Kx from index
720
Decrypt Sx using Kx to obtain Ix and Cx
730
740
Record in database for Ix?
N
Authorization failure
Y
750
Compare Ix to scrambling code(s) in record. Match?
Y
Clone suspected; validation unsuccessful
N
770
Select new Kx
Keys exhausted?
Y
Validation successful

FIG. 7B

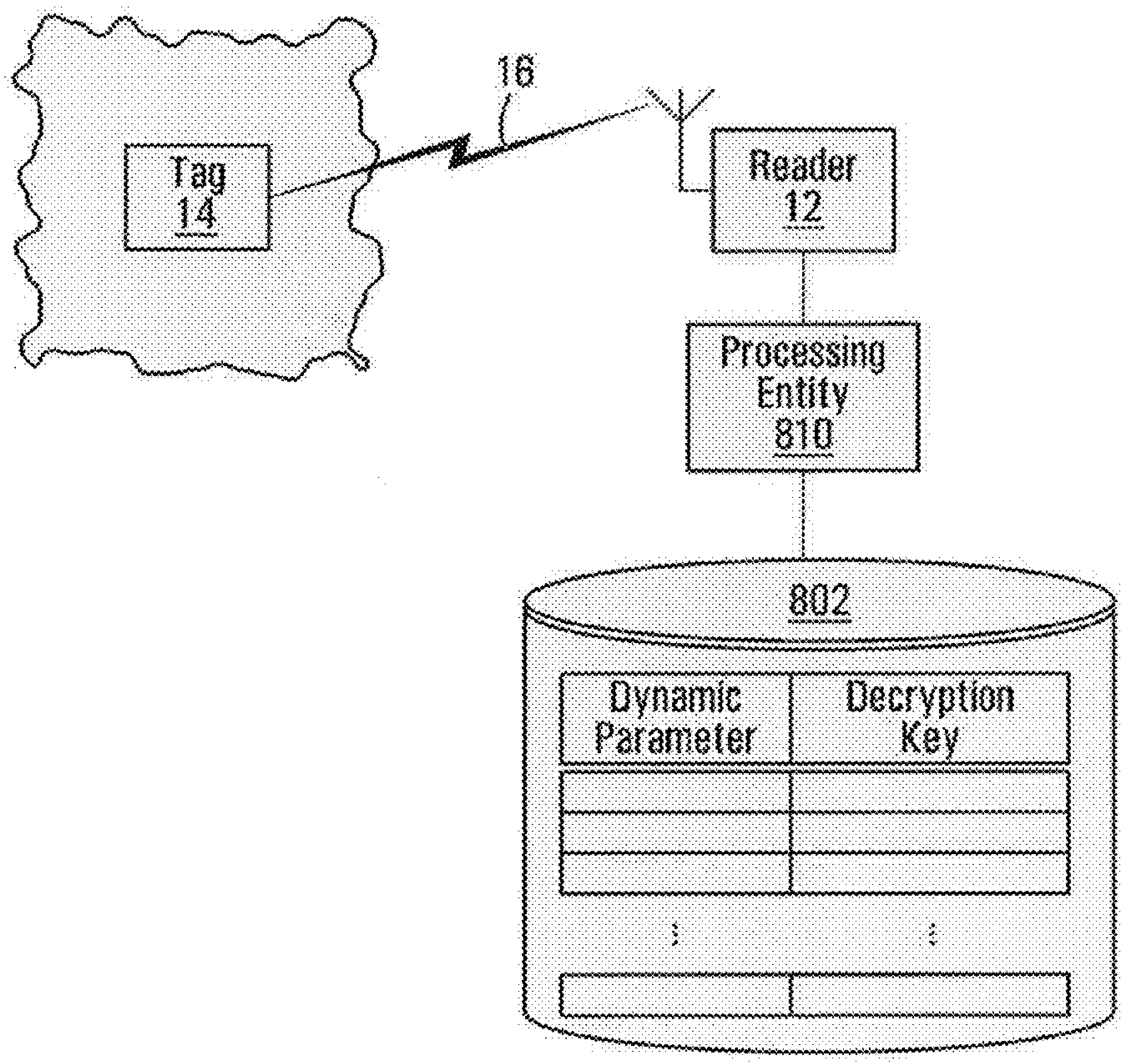

16
Tag
14
Reader
12
Processing
Entity
810
802
Dynamic
Parameter
Decryption
Key

FIG. 8

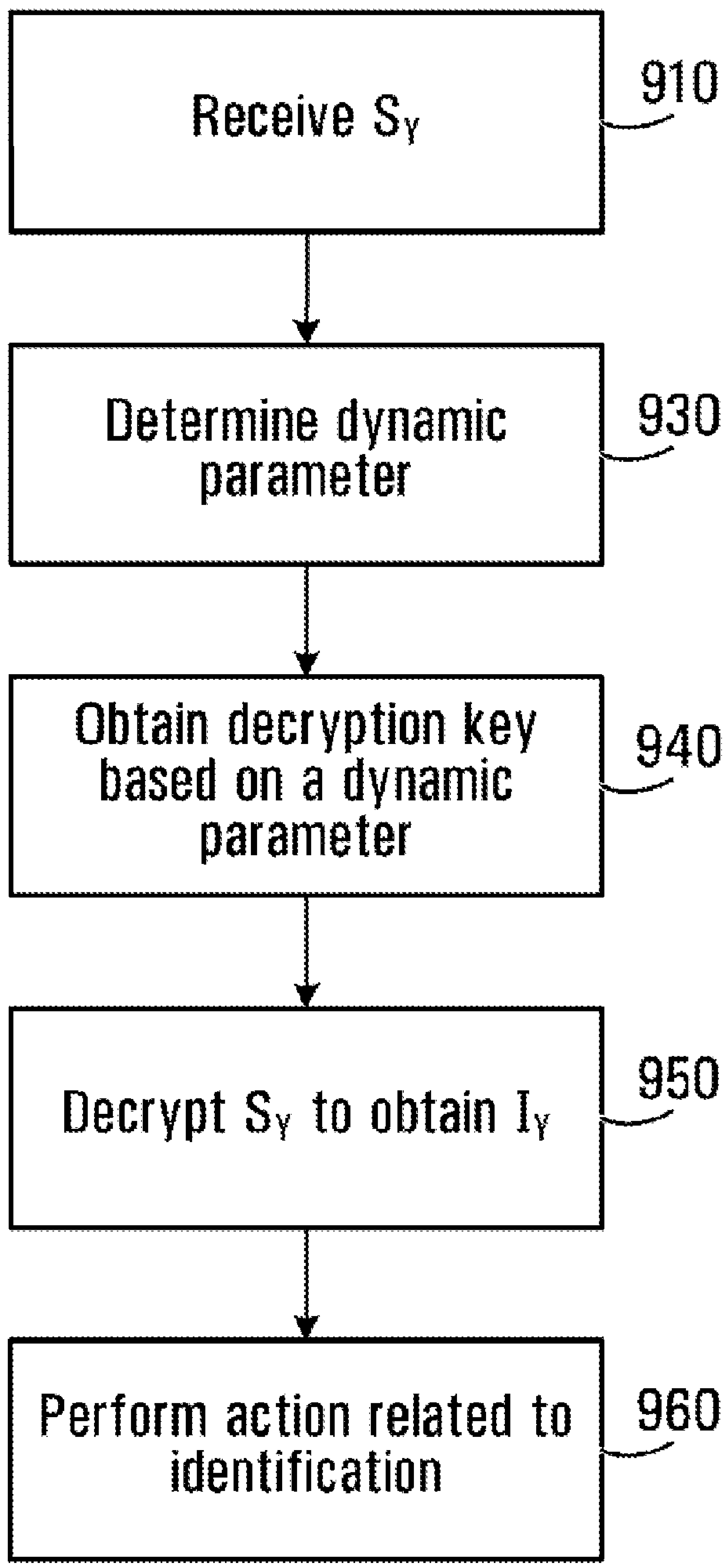

Receive S_Y
910
Determine dynamic parameter
930
Obtain decryption key based on a dynamic parameter
940
Decrypt S_Y to obtain I_Y
950
Perform action related to identification
960

FIG. 9

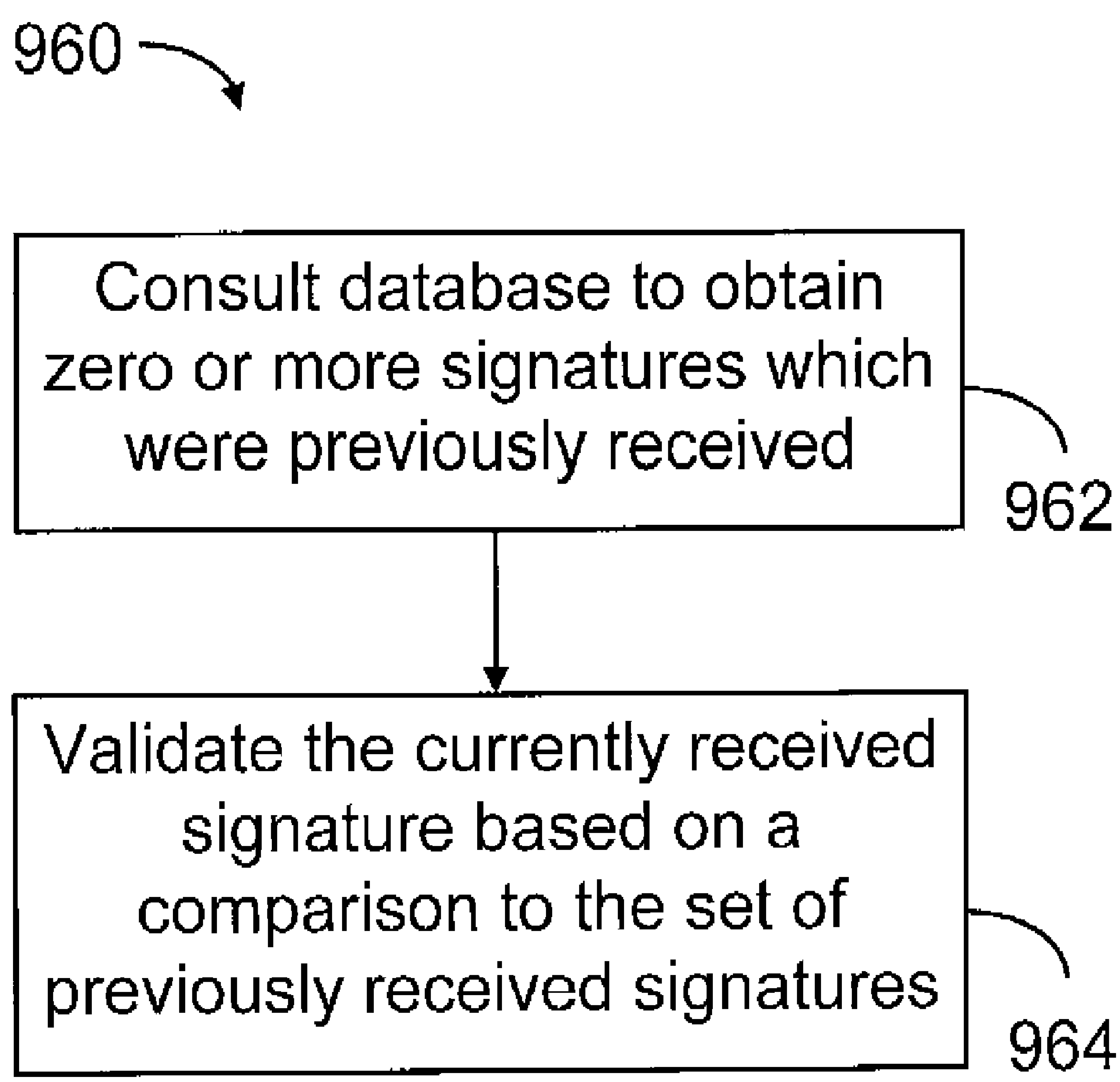

960
Consult database to obtain zero or more signatures which were previously received
962
Validate the currently received signature based on a comparison to the set of previously received signatures
964

FIG. 9A

METHOD AND SYSTEM FOR VALIDATING A DEVICE THAT USES A DYNAMIC IDENTIFIER

CROSS-REFERENCE TO RELATED APPLICATION

The present application is a continuation-in-part, and claims the benefit under 35 USC 120, of PCT International Application PCT/CA2007/002343, filed on Dec. 20, 2007 and hereby incorporated by reference herein.

FIELD OF THE INVENTION

The present invention relates generally to communication over a network and, more specifically, to a method for identification of a device when communicating with a network entity over the network.

BACKGROUND

In many everyday applications, such as access control, payment and tracking, devices involved in those applications need to be identified. Devices are typically assigned an identifier for such purposes. Thus, when the time comes for a device to be identified, the device transmits its assigned identifier to a network entity, which takes a decision as to whether the device (or a user thereof) is authorized to access a physical resource, view online content, utilize funds, etc.

In many situations, at least a portion of the pathway between a given device and the network entity might not be secure. For example, RFID, Bluetooth, WiFi, WiMax, Internet all present potential security risks whereby a malicious individual could detect and copy identifiers transmitted by the given device. Once the malicious individual gains knowledge of the given device's identifier, it is possible that he or she can simulate the given device and potentially gain access to a secured resource facility or vehicle, conduct unauthorized payments, impersonate the given device, etc.

Thus, an improved approach to the identification of devices would be welcome in the industry.

SUMMARY OF THE INVENTION

According to a first aspect, the present invention seeks to provide a method, comprising: obtaining a currently received signature from a device; obtaining a candidate identifier associated with the device; consulting a database to obtain a set of previously received signatures associated with the candidate identifier; and validating the currently received signature based on a comparison of the currently received signature to the set of previously received signatures associated with the candidate identifier.

According to a second aspect, the present invention seeks to provide a computer- readable storage medium comprising computer-readable program code which, when interpreted by a computing apparatus, causes the computing apparatus to execute a method that includes: obtaining a currently received signature from a device; obtaining a candidate identifier associated with the device; consulting a database to obtain a set of previously received signatures associated with the candidate identifier; and validating the currently received signature based on a comparison of the currently received signature to the set of previously received signatures associated with the candidate identifier.

According to a third aspect, the present invention seeks to provide a system for processing signatures received from devices, comprising: an interrogation portion configured to obtain a currently received signature from a particular device and a candidate identifier associated with the particular device; and a processing portion configured to consult a database in order to obtain a set of previously received signatures associated with the candidate identifier; and to validate the currently received signature based on a comparison of the currently received signature to the set of previously received signatures associated with the candidate identifier.

According to a fourth aspect, the present invention seeks to provide a method, comprising: obtaining a currently received signature from a device; decrypting the currently received signature to obtain a candidate identifier; and a candidate scrambling code; consulting a database to obtain a set of previously received scrambling codes associated with the candidate identifier; and validating the currently received signature based on a comparison of the candidate scrambling code to the set of previously received scrambling codes associated with the candidate identifier.

According to a fifth aspect, the present invention seeks to provide a computer-readable storage medium comprising computer-readable program code which, when interpreted by a computing apparatus, causes the computing apparatus to execute a method that includes: obtaining a currently received signature from a device; decrypting the currently received signature to obtain a candidate identifier; and a candidate scrambling code; consulting a database to obtain a set of previously received scrambling codes associated with the candidate identifier; and validating the currently received signature based on a comparison of the candidate scrambling code to the set of previously received scrambling codes associated with the candidate identifier.

According to a sixth aspect, the present invention seeks to provide a system for processing signatures received from devices, comprising: an interrogation portion configured to obtain a currently received signature from a particular device; and a processing portion configured to: decrypt the currently received signature in order to obtain a candidate identifier and a candidate scrambling code; consult a database in order to obtain a set of previously received scrambling codes associated with the candidate identifier; and validate the currently received signature based on a comparison of the candidate scrambling code to the set of previously received scrambling codes associated with the candidate identifier.

These and other aspects and features of the present invention will now become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. **1** is a block diagram of a system comprising a reader and a tag, in accordance with a non-limiting embodiment of the present invention.

FIG. **2** is a block diagram showing details of the tag, in accordance with a non-limiting embodiment of the present invention.

FIG. **3** illustrates a decoding function implemented by a controller in the tag, for generation of a signature at two points in time.

FIGS. **4**A and **4**B depict two possible functional architectures for generation of a signature.

FIG. **5** is a block diagram of a system comprising a device in communication with a network entity.

FIG. **6**A shows application of a non-limiting embodiment of the present invention in a validation context.

FIG. **6**B is a block diagram of a multi-reader architecture, in accordance with a non-limiting embodiment of the present invention.

FIG. **7**A is a flowchart showing operation of a processing entity of FIG. **6** when considering tags whose signatures encode a variable scrambling code and that are encrypted using a common key that is known to the reader or can be determined from an index supplied with the signature.

FIG. **7**B is a flowchart similar to that of FIG. **7**A, but where the common key is unknown to the reader.

FIG. **8** shows application of a non-limiting embodiment of the present invention in an identification context when considering tags whose signatures are encrypted using a variable key.

FIG. **9** and FIG. **9**A, together referred to hereinafter as FIG. **9**, are flowcharts showing operation of a processing entity of FIG. **8** when considering tags whose signatures are encrypted using a variable key.

It is to be expressly understood that the description and drawings are only for the purpose of illustration of certain embodiments of the invention and are an aid for understanding. They are not intended to be a definition of the limits of the invention.

DETAILED DESCRIPTION

With reference to FIG. **5**, there is shown a system comprising a device **1000** in communication with a network entity **1002**. The network entity **1002** controls access to a resource **1004**. The resource **1004** can be any desired resource to which the device **1000** (or a user thereof) may wish to gain access. Non-limiting examples of the resource **1004** include real property (e.g., computing equipment, a computer network, a building, a portion of a building, an entrance, an exit, a vehicle, etc.), online property (e.g., access to a network such as the Internet or a virtual private network, a user account on a website, etc.) and financial property (e.g., a credit card account, bank account, utility company account, etc.).

The network entity **1002** may in some embodiments comprise an interrogation portion **1010** and a processing portion **1012**. Depending on the embodiment, the interrogation portion **1010** may take the form of an RFID reader, a server, a modem, a WiFi node, a WiMax node, a base station, an infrared/Bluetooth receiver, etc. The interrogation portion **1010** communicates with the network device **1002** over a communication pathway **1014**. In a non-limiting example, the communication pathway **1014** may traverse the Internet. Alternatively or in addition, the communication pathway **1014** may traverse the public switched telephone network (PSTN). The communication pathway **1014** may include one or more portions, any one or more of which may physically consist of one or more of a wireless, guided optical or wired link. Non-limiting examples of a wireless link include a radio frequency link and a free-space optical link, which may be established using any suitable protocol, including but not limited to RFID, Bluetooth, WiFi, WiMax, etc. Furthermore, the wireless link may be fixed wireless or mobile wireless, to name but two non-limiting possibilities.

The processing portion **1012** of the network entity **1002** is in communication with the interrogation portion **1010** and obtains therefrom data obtained as a result of interaction with the device **1000**. The processing portion **1012** has the ability to process the data obtained by the interrogation portion **1010** and to determine whether or not to grant access to the resource **1004**.

The device **1000** can be any suitable device that is susceptible of being used to access the resource **1004**. In one non-limiting example, the device may take the form of a contactlessly readable tag (e.g., an RFID tag) that can be affixed to or integrated with: an item for sale, transported merchandise, a person's clothing, an animal (including livestock), a piece of equipment (including communications equipment such as wireless communications equipment), a vehicle, an access card and a credit card, to name just a few non-limiting examples. In another non-limiting example, the device **1000** may take the form of a communication device (e.g., a mobile telephone (including smart phones and networked personal digital assistants), a computer (e.g., desktop or laptop), a modem, a network adapter, a network, interface card (NIC), etc.).

The device **1000** comprises a memory **1016** and a processing entity **1020** (e.g., a microcontroller) that is coupled to the memory **1020**. The processing entity **1020** has the ability to execute computer-readable instructions stored in the memory **1016** which, upon execution, result in the device **1000** implementing a desired process or application. In a non-limiting example, the application is a software application, such as a telephony or banking application, to give but two non-limiting examples.

The memory **1016** includes a memory element **1018** that stores an identifier I_D of the device **1000**. Depending on the type of device, the identifier may be configured differently.

For example, in the case where the device **1000** takes the form of an RFID tag, the identifier I_D may be an identifier specifically used in RFID tags and may encode information such as, without limitation, a serial number, a universal product code (UPC), a vehicle registration number (VIN), an account number and a customized identifier.

In the case where the device **1000** takes the form of a communication device that is a mobile telephone, the identifier I_D may be an electronic serial number of the mobile telephone.

In the case where the device **1000** takes the form of a network adapter or NIC, the identifier I_D may be a manufacturer-assigned identifier associated with the communication device. A non-limiting example of a suitable identifier is a Media Access Control address (MAC address), Ethernet Hardware Address (EHA), hardware address, adapter address or physical address, which can be assigned to network adapter or NIC by the manufacturer for identification and can encode a registered identification number of the manufacturer.

In order to gain access to the resource, the device **1000** identifies itself to the network entity **1002** at certain instants hereinafter referred to as "identification occasions". Depending on the application at hand, the identification occasions can arise under control of the device **1000** (i.e., autonomously), under control of the network entity **1002** (e.g., in response to receipt of a request issued by the network entity **1002**) or under control of a user (not shown) of the device **1000**. For example, in the case of an application involving control of access to real property, an identification occasion may arise whenever the device **1000** is queried by an external reader, which may occur when the device **1000** is sensed by the reader to be within the vicinity thereof. In the case of an application involving control of access to online property, the device **1000** may autonomously identify itself to a remote modem on a regular or irregular basis (e.g., in the context of keeping a session alive). In the case of an application involving control of financial property, an identification occasion may arise at the discretion of the user of the device **1000**, e.g., when deciding to make a purchase. In such a case, the device **1000** may comprise an interface with the user that senses user input and can detect or decode when a transaction is taking place or is about to take place.

In accordance with non-limiting embodiments of the present invention, when identifying itself, the device **1000** releases a "signature". Over the course of time, it is assumed that the device **1000** will identify itself to the network entity on at least two identification occasions, which will result in the release of a "signature" each time. As will be described in greater detail herein below, the signatures released on different identification occasions will be different, but all encode the same identifier I_D of the device **1000**. Changes to the signature can be effected by the processing entity **1020** which interacts with the memory **1016**.

To take the specific non-limiting example embodiment of an RFID environment, reference is now made to FIG. **1**, where the interrogation portion **1010** of the network entity **1002** is implemented as a reader **12** and where the device **1000** is implemented as a contactlessly readable tag **14**, a non-limiting example of which is an RFID tag. Communication between the reader **12** and the tag **14** occurs over a contact-less medium **16**. In a specific non-limiting embodiment, the contact-less medium **16** is a wireless medium that may include a spectrum of radio frequencies. As described earlier, the tag **14** could be affixed to or integrated with: an item for sale, transported merchandise, a person's clothing, an animal (including livestock), a piece of equipment (including communications equipment such as wireless communications equipment), a vehicle, an access card and a credit card, to name jut a few non-limiting examples. For its part, the reader **12** can be fixed or mobile. In the fixed scenario, the reader **12** could be located at any desired position within a building, vehicle, warehouse, campus, etc. In the mobile scenario, the reader **12** could be implemented in a handheld or portable unit, for example.

FIG. **2** shows details of the tag **14**, in accordance with a specific non-limiting embodiment of the present invention. The tag **14** comprises a memory **202** (which can be a possible implementation of the memory **1016**), transmit/receive circuitry **204** (including an antenna), a controller **206** and a power source **208**.

The memory **202** includes a memory element **203** (which can be a possible implementation of the memory element **1018**) that stores the identifier I_D. In addition, the memory **202** stores a current signature **212**. In addition, the memory **202** may store a program for execution by the controller **206**, including computer-readable program code for causing the controller **206** to execute various steps and achieve wide-ranging functionality. In a non-limiting embodiment, the current signature **212** can take the form of a bit pattern having a certain number of bits. In accordance with an embodiment of the present invention, the bit pattern exhibited by the current signature **212** is dynamic, that is to say the current signature **212** changes over time.

The controller **206** executes various functions that allow communication to take place via the transmit/receive circuitry **204** between the tag **14** and an external reader such as the reader **12**. In what follows, communications will hereinafter be referred to as occurring with the reader **12** although it will be appreciated that the tag **14** may communicate similarly with other external readers that it encounters.

As part of its functionality, the controller **206** is operative to retrieve the current signature **212** from the memory **202** and to release the current signature **212** via the transmit/receive circuitry **204**. Alternatively, depending on the computational capabilities of the controller **206**, the controller **206** can be operative to compute the current signature **212** on demand and to release via the transmit/receive circuitry **204** the current signature **212** so computed.

It is recalled that in this embodiment, the current signature **212** is dynamic. Accordingly, the controller **206** is operative to communicate with the memory **202** in order to change the bit pattern of the current signature **212** stored in the memory **202**. This can be achieved by executing diverse functionality that will be described in greater detail later on, and which may include implementing functional elements such as an encryption engine **222**, a counter **230**, a pseudo-random number generator **240**, a geo-location module **250** and a clock module **260**, among others.

The configuration of the power source **208** and its interrelationship with the controller **206** depend on whether the tag **14** is categorized as "passive", "active" or somewhere in between. Specifically, the tag **14** may be designed as "passive", whereby transmissions of the current signature **212** via the transmit/receive circuitry **204** are effected in response to detection of a burst of energy via the transmit/receive circuitry **204**, such burst of energy typically coming from the reader **12** issuing a "read request". In this case, the controller **206** only needs to be powered during the short time period following the detection of the burst. In fact, the burst itself can charge the power source **208** for a brief period, enough to allow the controller **206** to cause transmission of the current signature **212** via the transmit/receive circuitry **204** in response to the read request. The current signature **212** may be extracted from the memory **202** or it may be generated on demand, upon receipt of the read request.

Alternatively, in some embodiments of an "active" tag, transmissions of the current signature **212** via the transmit/receive circuitry **204** are similarly effected in response to detection of a read request via the transmit/receive circuitry **204**. In this case, the availability of the power source **208** allows the controller **206** to transmit the current signature **212** at a longer range than for passive devices. Certain active tags also have the capability to switch into a passive mode of operation upon depletion of the power source **208**. In other embodiments of an active tag, transmissions of the current signature **212** are effected via the transmit/receive circuitry **204** at instances or intervals that are controlled by the controller **206**. This can be referred to as autonomous (or unsolicited) issuance of the current signature **212**. To this end, the controller **206** needs to be continuously powered from the power source **208**.

Active and passive tags may have other features that will be known to those of skill in the art.

In still other cases, the power source **208** (either continually storing a charge or accumulating a sensed charge) can be connected to the controller **206** via a switch **210**, which is optional. The switch **210** can be toggled between a first state during which an electrical connection is established between the power source **208** and the controller **206**, and a second state during which this electrical connection is broken. The switch **210** is biased in the second state, and can be placed into the first state. Toggling into the first state can be achieved by a burst of energy that is sensed at a sensor (not shown) or by use of an activation element. In various non-limiting embodiments, the activation element may be a touch-sensitive pad on a surface of the tag **14**, or a mechanical component (e.g., a button). Placing the switch **210** into the first state may also trigger the controller **260** to change the current signature **212** in the memory **202**.

With reference now to FIG. **3**, there is shown conceptually how the current signature **212** stored in the memory **202** may change over time. Specifically, different versions of the current signature **212** (denoted S_A and S_B) are generated by an encoding function **302** implemented by the controller **206**. For notational convenience, the current signature **212** is used to denote which of the two signatures S_A, S_B is currently stored in the memory **202**. The encoding function **302** generates the signatures S_A and S_B by encoding the aforementioned identifier I_D (which, as will be recalled, is the identifier of the device **1000**, to which is affixed the tag **14** in this example embodiment) with a respective "additional data set" (denoted D_A and D_B) at respective time instants (denoted T_A and T_B). Thus, at T_A, the signature S_A is generated by encoding the identifier I_D with the additional data set D_A, whereas at T_B, the signature S_B is generated by encoding the identifier I_D with the additional data set D_B. While in this example, two time instants are shown and described, this is solely for simplicity, and it should be understood that in actuality, the current signature **212** may change many times.

In accordance with a non-limiting embodiment of the present invention, the additional data sets D_A and D_B are different, which makes both signatures S_A, S_B different. In fact, the two signatures S_A, S_B will appear scrambled relative to one another due to use of the encryption engine **222** within the encoding function **302**. More specifically, the signatures S_A and S_B can be generated from the additional data sets D_A and D_B in a variety of ways, two of which will be described herein below.

First Approach

In a first approach, described with reference to FIG. **4**A, the identifier I_D is encrypted by the encryption engine **222** with a dynamic key—represented by the additional data sets D_A, D_B themselves, resulting in the two signatures S_A, S_B. The two signatures S_A, S_B will be different because the additional data sets D_A, D_B are different. In fact, they will appear scrambled relative to one another when observed by someone who has not applied a decryption process using a counterpart to the keys used by the encryption engine **222**.

It will be noted that in order to make the first approach practical, the reader **12** needs to have knowledge of which key (i.e., which of the additional data sets D_A, D_B) was used for encryption of a received one of the signatures S_A, S_B, in order to effect proper decryption and recover the identifier I_D. For this purpose, in order to assist the reader **12** in identifying the correct key to be used for decryption, and with reference again to FIG. **2**, the current signature **212** may be accompanied by an index **214** also stored in the memory **202**. The index **214** may point the reader **12** to the correct key to be used. The reader **12** may have access to a key database (not shown) for this purpose.

For example, consider the case where the keys (in this case, the additional data sets D_A, D_B) correspond to outputs of the pseudo-random number generator **240** having a seed known a priori to the tag **14** and to the reader **12**. Here, at T_A, the index **214** may indicate the sequential position in the output of the pseudo-random number generator **240** that corresponds to the additional data set D_A, while at T_B, the index **214** may indicate the sequential position in the output of the pseudo-random number generator **240** that corresponds to the additional data set D_B. The reader **12** can then easily find the value occupying the correct sequential position in the output of an identical local pseudo-random number generator and effect successful decryption of the received signature (S_A or S_B).

Alternatively, the keys (in this case, the additional data sets D_A, D_B) are provided by the reader **12**. This can be done where the reader **12** (or an entity associated therewith) decides that a change in the current signature **212** is required. As a variant, the reader **12** may issue a trigger which, when received by the controller **206**, causes the controller **206** to effect a change in the current signature **212**. In such cases, changes to the key (and thus to the current signature **212**) are effected by the controller **206** in response to triggers received from the reader **12**.

Second Approach

For other applications, the approach of FIG. **4**B may be useful. Here, the identifier I_D is augmented with differing scrambling codes (denoted C_A and C_B), and then encrypted by the encryption engine **222** with a common key (denoted K), thus producing the two signatures S_A, S_B. The "additional data set" D_A used for encryption at T_A is therefore composed of the key K and the scrambling code C_A, while the "additional data set" D_B used for encryption at T_B is composed of the same key K and the scrambling code C_B. The encryption process can be designed so that small differences (in terms of the number of bits where there is a difference) between the scrambling codes C_A and C_B will cause large differences (in terms of the number of bits where there is a difference) in the resultant signatures S_A and S_B. Thus, the scrambling codes C_A, C_B have the effect of scrambling (i.e., randomizing) the resultant signatures S_A, S_B.

The controller **206** is responsible for determining which scrambling code is to be used to generate a particular signature at a particular time instant. The current version of the scrambling code can be stored in the memory **202** and is denoted **220** for convenience. It will be appreciated based on the above description that the scrambling code C_A corresponds to the current scrambling code **220** at T_A and that the scrambling code C_B corresponds to the current scrambling code **220** at T_B.

Continuing with the second approach, several classes of embodiments are contemplated for changing the current scrambling code **220**. In a first class of embodiments relevant to the approach of FIG. **4**B, the current scrambling code **220** is changed in a way that can be predicted by the reader **12**, that is to say, where the reader **12** (or an entity associated therewith) has knowledge of how each successive scrambling code is generated.

For example, the current scrambling code **220** can be changed each time (or, generally, each N^{th} time where $N \geq 1$) that the controller **206** receives a read request or releases the current signature **212** in response to a read request. This can ensure that the current signature **212** is different each N^{th} time that the controller **206** receives a read request. Alternatively, the current scrambling code **220** is changed every the current scrambling code **220** can be changed every set period of time (ex. every N seconds, minutes, hours, days, etc.). The variations in the current scrambling code **220** may governed in a variety of ways that are predictable to the reader **12**. For example, the controller **206** may implement a counter **230**, whose output is incremented (by a step size that can equal unity or can be negative, for example) after each N^{th} time that the controller **206** responds to a read request received from a nearby reader (or each N seconds, etc.). If the current scrambling code **220** is set to correspond to the current output of the counter **230**, then the scrambling codes C_A, C_B used to generate the two signatures S_A, S_B will differ by the step size.

Alternatively, the controller **206** may implement the aforesaid pseudo-random number generator **240**, which produces an output that depends on one or more previous values of the output and on a seed. If the current scrambling code **220** is set to correspond to the current output of the pseudo-random number generator **240**, then the scrambling codes C_A, C_B used to generate the two signatures S_A, S_B will differ in accordance with the characteristics of the pseudo-random number generator **240**.

Other variants will become apparent to those of skill in the art without departing from the scope of the present invention.

In a second class of embodiments relevant to the approach of FIG. **4**B, the additional data sets D_A, D_B are not only predicted by the reader **12** but are actually controlled by the reader **12**. This can be useful where the reader **12** (or an entity associated therewith) decides that a change in the current signature **212** is required. Alternatively, and recognizing that the key K is common to both of the additional data sets D_A, D_B, the reader **12** could supply the unique portions of the additional data sets D_A, D_B, namely the scrambling codes C_A, C_B.

As a variant, the reader **12** may simply issue a trigger which, when received by the controller **206**, causes the controller **206** to effect a change in the current signature **212**. In such cases, changes to the current signature **212** are effected by the controller **206** in response to triggers received from the reader **12**.

In a third class of embodiments relevant to the approach of FIG. **4**B, it may be desired to change the signatures S_A, S_B in a stochastic way, that is to say, without the need to follow an underlying pattern that could be predicted by the reader **12**.

For example, the controller **206** may implement the aforementioned geo-location module **250**, which is configured to output a current spatial position of the tag **14** or of an item, person, vehicle, etc., to which it is affixed. If the current scrambling code **220** is set to correspond to the current output of the geo-location module **250**, then the scrambling codes C_A, C_B used to generate the two signatures S_A, S_B will differ in a stochastic fashion.

Alternatively, the controller **206** may implement a clock module **260**, which is configured to determine a current time. If the current scrambling code **220** is set to correspond to a value measured by the clock module **260** (e.g., number of milliseconds elapsed since midnight of the day before), then the scrambling codes C_A, C_B used to generate the two signatures S_A, S_B will differ in a stochastic fashion.

Although the foregoing description has focused on a non-limiting example wherein the device **1000** bore the tag **14**, wherein the interrogation portion **1010** of the network entity **1002** consisted of the reader **12** and the communication pathway **1014** was a wireless medium, it should be apparent to persons of skill in the art that there exist many other embodiments of the present invention with application to a wide variety of other scenarios, as has been mentioned earlier.

In view of the above, it should thus be appreciated that a common identifier of the device **1000** is encoded within a plurality of signatures that vary over time for the same device **1000**. This identifier can be extracted by the network entity **1002** (either the interrogation portion **1010** or the processing portion **1012**, as applicable) by utilizing the appropriate key for decryption. This allows the network entity **1002** to perform a variety of functions, including but not limited to validation of the identifier based on the signature and/or the scrambling code (hereinafter "scenario (I)") and/or an action related to identification, based on the identifier (hereinafter, "scenario (II)"). Both of these scenarios, which are not mutually exclusive, are now described in some detail, again in the specific non-limiting example embodiment of an RFID environment.

In scenario (I), a dynamic scrambling code is used in the generation of a signature that continually encodes the same identifier, and it is of interest to recover the current scrambling code to detect a potential instance of tag cloning. Accordingly, with reference to FIG. **6**A, there is shown a system that is similar to the system of FIG. **1**. In addition, the system of FIG. **6**A comprises a processing entity **610** that implements a validation operation, as will be described herein below. In various embodiments, the processing entity **610** referred to above may be connected to the reader **12**, or it may be a remote entity. Such a remote entity may be reachable over a network, or it may be integrated with the reader **12**. Thus, the processing entity **610** may be part of the network entity **1002** or, more specifically, part of the processing portion **1012**.

The system of FIG. **6**A also includes a storage entity, such as a database **602**, that is accessible to the processing entity **610** and stores a plurality of records **604**, each associated with a respective identifier. For the purposes of the present example, one can consider that each identifier for which there exists a record in the database **602** is indicative of a privilege to access certain property or make certain transactions, although other scenarios are possible without departing from the scope of the present invention.

In accordance with one embodiment of the present invention, each of the records **604** also comprises a field **606** indicative of zero or more scrambling codes **608** that were encoded in signatures which were previously received and which encoded the respective identifier for that record. Thus, receipt of a particular signature that encodes the identifier in a given one of the records **604** as well as one of the scrambling code(s) **608** stored in the corresponding field **606** will indicate that the particular signature has been previously received and therefore its instant receipt may be indicative that a cloning attempt has been made.

More specifically, with reference to the flowchart in FIG. **7**A, consider what happens following step **710** when a signature S_X is received at a particular time instant by the reader **12**. At the time of receipt, whether the signature S_X encodes any particular identifier or scrambling code is unknown to the reader **12**. At step **730**, an attempt to decrypt the signature S_X is made by the processing entity **610** using a decryption key K_X. The decryption key K_X may be known in advance to the processing entity **610**. Alternatively, as shown in step **720**, the signature S_X may be accompanied by an index that allows the processing entity **610** to determine the appropriate decryption key K_X. The result of the decryption attempt at step **730** is a candidate identifier I_X and a candidate scrambling code, denoted C_X.

At step **740**, the processing entity **610** consults the database **602** based on the candidate identifier I_X in an attempt to identify a corresponding record and extract therefrom a list of scrambling code(s) that have been received in the past in association with the candidate identifier I_X. For the purposes of the present example, it is useful to assume that such a record exists (i.e., the "YES" branch is taken out of step **740**), but if there is no such record, this may indicate that there is a high-level failure requiring further action. At step **750**, the processing entity **610** compares the candidate scrambling code C_X to the scrambling code(s) **608** in the field **606** of the record identified at step **740** and corresponding to identifier I_X.

If there is a match, this indicates that the scrambling code C_X has been used in the past in association with the identifier I_X. Under certain conditions, this may lead the processing entity **610** to conclude that the validation operation was unsuccessful.

For example, if the signature S_X was expected to change at least as often as every time that the tag on which it is stored was read, then the fact that the scrambling code C_X matches one of the scrambling code(s) **608** stored in the field **606** of the record corresponding to identifier I_X may lead the processing entity **610** to conclude that the validation operation was unsuccessful. Alternatively, if the signature S_X was expected to change every N^{th} time that the tag on which it is stored was read, then the processing entity **610** may look at how many of the scrambling code(s) **608** stored in the field **606** of the record corresponding to identifier I_X correspond to the scrambling code C_X, and if this number is greater than or equal to N, this may lead the processing entity **610** to conclude that the validation operation was unsuccessful. Alternatively still, if the signature S_X was expected to change at least as often as every N seconds etc., then the processing entity **610** may look at how long ago it has been since a matching one of the scrambling code(s) **608** was first stored in the field **606** of the record corresponding to identifier I_X, and if this time interval is greater than or equal to a pre-determined number of seconds, minutes, hours, days, etc., this may lead the processing entity **610** to conclude that the validation operation was unsuccessful.

Where a conclusion is reached that the validation operation was unsuccessful, the privilege to access the property or make transactions may be revoked or at least questioned on the basis of suspected tag cloning.

On the other hand, if there is no match between the scrambling code C_X and any of the scrambling code(s) **608** stored in the field **606** of the record corresponding to identifier I_X, this may lead the processing entity **610** to conclude that the validation operation was potentially successful. In such a case, the default privilege to access the property or make transactions may be granted (or at least not revoked on the basis of suspected tag cloning).

In accordance with an alternative embodiment of the present invention, the field **606** in the record associated with each particular identifier may be indicative of an "expected" scrambling code, i.e., the scrambling code that should (under valid circumstances) be encoded in a signature received from a tag that encodes the particular identifier. Alternatively, the field **606** in the record associated with each particular identifier may be indicative of an "expected" signature, i.e., the signature that should (under valid circumstances) be received from a tag that encodes the particular identifier. Thus, upon receipt of the signature S_X, if it is found to correspond to the expected signature (or if the scrambling code C_X is found to correspond to the expected scrambling code), this may lead the processing entity **610** to conclude that the validation operation was potentially successful. On the other hand, if there is no match between the signature S_X and the expected signature stored in the database **602** (or between the scrambling code C_X and the expected scrambling code), this may lead the processing entity **610** to conclude that the validation operation was unsuccessful.

It should be appreciated that in the above alternative embodiments, the processing entity **610** may obtain knowledge of the expected scrambling code or the expected signature by implementing plural pseudo-random number generators for each of the identifiers, analogous to the pseudo-random number generator **240** implemented by the controller **206** in a given tag **14**, which produces an output that depends on one or more previous values of the output and on a seed. Thus, the next output of the pseudo-random number generator implemented by the processing entity **610** for a given identifier allows the processing entity **610** to predict the scrambling code (or the signature) that should be received from a tag legitimately encoding the given identifier. In another embodiment, the processing entity **610** may know what is the expected scrambling code/signature because it has instructed the reader **12** to cause this expected scrambling code/signature to be stored in the memory of the tag.

In accordance with an alternative embodiment of the present invention, the database **602** simply comprises a running list of all signatures that have been received in the past. Thus, upon receipt of the signature S_X, if it is found to correspond to one of the signatures on the list, this may lead the processing entity **610** to conclude that the validation operation was unsuccessful. On the other hand, if there is no match between the signature S_X and any of the signatures stored in the database **602**, this may lead the processing entity **610** to conclude that the validation operation was potentially successful (or at least not unsuccessful).

It should also be appreciated that having obtained the identifier I_X, the processing entity **610** may also perform an action related to identification of an item, vehicle, person, etc., associated with the particular tag that encoded the identifier I_X.

In a first example of an action related to identification, the processing entity **610** may simply note the fact that the item, vehicle, person, etc. (bearing the identifier I_X) was encountered in a vicinity of the reader **12**. This information may be stored in a database (not shown) or sent as a message, for example. In an inventory management scenario, the processing entity **610** may consult an inventory list and "check off" the inventory item as having been located, or may signal that the presence of a spurious inventory item (i.e., one that is not on the inventory list) has been detected.

In another example of an action related to identification, the processing entity **610** may consult another database (not shown) in order to ascertain whether the identifier is on a list of identifiers associated with individuals/objects permitted to access, or prohibited from accessing, certain property. Examples of property include, without limitation: computing equipment, a computer network, a building, a portion of a building, an entrance, an exit and a vehicle.

In another example of an action related to identification, the processing entity **610** may consult another database (not shown) in order to ascertain whether the identifier is on a list of identifiers associated with individuals permitted to effect, or prohibited from effecting, a transaction, which could be a financial transaction or a login to controlled online content, for example.

FIG. **7**B shows a variant where multiple keys are possible but no index (or one that does not permit identification of the appropriate decryption key) is provided along with the signature S_X. Specifically, taking the "NO" branch after step **750** does not conclude the validation operation. Rather, the validation operation goes through step **770** where a next key is selected and then the validation operation returns to step **730**, whereby steps **730** through **770** are re-executed until the earlier occurrence of (i) taking the "YES" branch at step **750** and (ii) exhaustion of all keys, which can result in the equivalent of taking the "NO" branch out of **740** (i.e., this may indicate that there is a high-level failure requiring further action).

It should be appreciated that in the above embodiments, encryption and decryption can be effected using various techniques known in the art, including encryption using a symmetric key, an asymmetric key pair, a public/private key pair, etc., as well as in accordance with a variety of algorithms and protocols For example, RSA and ECC are suitable examples of asymmetric encryption algorithms, while AES, DES, and Blowfish are suitable examples of symmetric algorithms. Still other possibilities exist and are within the scope of the present invention.

In the above example with reference to FIGS. **6**A, **7**A and **7**B, although a single reader was described and illustrated, it should be appreciated that it is within the scope of the present invention to provide a multi-reader architecture, as shown in FIG. **6**B. A plurality of readers **662** are connected to each other and to a centralized control entity **660** by a network **680**, which can be a public packet-switched network, a VLAN, a set of point-to-point links, etc. In such a case, the centralized control entity **660** (e.g., a network controller) can implement the combined functionality of each individual processing entity **610**, including decryption and validation. To this end, the centralized control entity **660** maintains a master database **670**, which includes the equivalent of a consolidated version of various instances of the database **602** previously described as being associated with the reader **12** in the single-reader scenario.

Thus, decryption and validation can be performed entirely in the centralized control entity **660**. Alternatively, certain functionality (such as decryption) can be performed by the readers **662** while other functionality (such as validation) can be performed by the centralized control entity **660**. Still alternatively, the processing entities **610** can inter-operate amongst themselves in the absence of the centralized entity **660**, thereby to implement decryption on a local basis, and the validation operation in a joint fashion. In such a distributed scenario, the master database **670** can still be used, or the processing entities **610** can communicate with one another to share information in their respective databases **602**.

In scenario (II), a dynamic key is used in the generation of a signature that encodes a constant identifier, and it is of interest to recover the underlying identifier despite the time-varying key. Accordingly, with reference now to FIG. **8**, there is shown a system that is similar to the system of FIG. **1**. In addition, the system of FIG. **8** comprises a processing entity **810** that implements an identification operation, as will be described herein below. The processing entity **810** may be connected to the reader **12**, or it may be a remote entity. Such a remote entity may be reachable over a network, or it may be integrated with the reader **12**. Thus, the processing entity **810** may be part of the network entity **1002** or, more specifically, part of the processing portion **1012**. It should be understood that the system in FIG. **8** is being shown separately from the system in FIG. **6**; however, it is within the scope of the present invention to combine the functionality of both systems.

With reference to the flowcharts in FIG. **9** and FIG. **9**A, together referred to hereinafter as FIG. **9**, consider what happens following step **910** when a signature S_Y is received from a particular tag at a particular time instant by the reader **12**. The signature S_Y is assumed to have been generated by encrypting an identifier I_Y using an encryption key that varies in a dynamic fashion. To this end, the particular tag may have generated the dynamic encryption key based on, for example:

- the output of the aforementioned clock module **260** (e.g., in terms of seconds, minutes or hours of elapsed time since an event known also to the processing entity **810**);
- the output of the aforementioned geo-location module **250**;
- an index;
- a seed for use by a pseudo-random number generator.

Still other possibilities are within the scope of the present invention. The decryption key can then be determined based on the above quantity. For example, the decryption key could be the above-mentioned output of the clock module or the geo-location module. Alternatively, the encryption key could be the output of a table **802** or a pseudo-random number generator (both known to the processing entity **810**) based on the above-mentioned seed, or at a position that corresponds to the above-mentioned index. In the latter case, the index or seed can be supplied along with the signature S_Y.

In accordance with the present embodiment, once the signature S_Y is read by the reader **12**, the processing entity **810** is expected to determine the appropriate decryption key, denoted K_Y. Accordingly, at step **930**, the processing entity **810** first determines a dynamic parameter that will allow the decryption key K_Y to be determined. Examples of the dynamic parameter include:

- the output of a clock module (which attempts to emulate the aforementioned clock module **260**) at the time of receipt of the signature S_Y (e.g., in terms of seconds, minutes or hours of elapsed time since a known event);
- the output of a geo-location module (which can be similar to the aforementioned geo-location module **250**);
- the index or seed provided along with the signature S_Y.

Next, at step **940**, the processing entity **810** obtains the decryption key K_Y based on the dynamic parameter determined at step **930**. For example, where the dynamic parameter corresponds to the output of a clock module or a geo-location module, the decryption key K_Y could be the dynamic parameter itself. Alternatively, where the dynamic parameter is an index or a seed, the decryption key K_Y could be the output of the aforementioned table **802** or pseudo-random number generator known to the processing entity **810**, at a position that corresponds to the received index, or using the received seed.

Once the decryption key has been obtained, the signature S_Y is decrypted at step **950** using the decryption key. This leads to extraction of the identifier I_Y. It is noted that a scrambling code was not required in this embodiment, although its use is not disallowed.

Having obtained the identifier I_Y, the processing entity **810** proceeds to step **960**, where it performs an action related to identification of an item, vehicle, person, etc., associated with the particular tag that encoded the identifier I_Y.

In a first example of an action related to identification, the processing entity **810** may simply note the fact that the item, vehicle, person, etc. (bearing the identifier I_Y) was encountered in a vicinity of the reader **12**. This information may be stored in a database (not shown) or sent as a message, for example. In an inventory management scenario, the processing entity **810** may consult an inventory list and "check off" the inventory item as having been located, or may signal that the presence of a spurious inventory item (i.e., one that is not on the inventory list) has been detected.

In another example of an action related to identification, the processing entity **810** may consult another database (not shown) in order to ascertain whether the identifier is on a list of identifiers associated with individuals/objects permitted to access, or prohibited from accessing, certain property.

Examples of property include, without limitation: computing equipment, a computer network, a building, a building, a portion of a building, an entrance, an exit and a vehicle.

In yet another example of an action related to identification, the processing entity **810** may consult another database (not shown) in order to ascertain whether the identifier is on a list of identifiers associated with individuals permitted to effect, or prohibited from effecting, a transaction, which could be a financial transaction or a login to controlled online content, for example.

It should be appreciated that the processing entity **810** may also perform an action related to validation **964** of the identifier I_Y in conjunction with the above action related to identification. Specifically, in accordance with one embodiment of the present invention, the processing entity may consult **962** a variant of the aforementioned database **602**, where each of the records **604** now includes a field indicative of zero or more signatures which were previously received and which encoded the respective identifier for that record. Thus, receipt of a particular signature that encodes the identifier in a given one of the records **604** as well as one of the signature(s) stored in the corresponding field will indicate that the particular signature has been previously received and therefore its instant receipt may be indicative that a cloning attempt has been made. For instance, the validation **964** may involve comparing the currently received signature to the set of zero or more previously received signatures, associated with the identifier I_Y, obtained from the aforementioned variant of the database **602**.

In the above example with reference to FIGS. **8** and **9**, although a single reader was described and illustrated, it should be appreciated that it is within the scope of the present invention to provide a multi-reader architecture, as in FIG. **6**B.

It should also be understood that the foregoing detailed description focused on a non-limiting example wherein the device **1000** bore the tag **14**, wherein the interrogation portion **1010** of the network entity **1002** consisted of the reader **12** and the communication pathway **1014** was a wireless medium. However, it should be apparent to persons of skill in the art that there exist many other embodiments of the present invention with application to a wide variety of other scenarios, as has been mentioned earlier.

Also, those skilled in the art will appreciate that in some embodiments, the functionality of any or all of the processing entity **610**, the processing entity **810**, the reader **12**, the readers **662**, the network entity **1002** (including the interrogation portion **1010** and the processing portion **1012**) and the processing entity **1020** may be implemented using pre-programmed hardware or firmware elements (e.g., application specific integrated circuits (ASICs), electrically erasable programmable read-only memories (EEPROMs), etc.), or other related components. In other embodiments, the functionality of the entity in question may be achieved using a computing apparatus that has access to a code memory (not shown) which stores computer-readable program code for operation of the computing apparatus, in which case the computer-readable program code could be stored on a medium which is fixed, tangible and readable directly by the entity in question (e.g., removable diskette, CD-ROM, ROM, fixed disk, USB drive), or the computer-readable program code could be stored remotely but transmittable to the entity in question via a modem or other interface device (e.g., a communications adapter) connected to a network (including, without limitation, the Internet) over a transmission medium, which may be either a non-wireless medium (e.g., optical or analog communications lines) or a wireless medium (e.g., microwave, infrared or other transmission schemes) or a combination thereof.

While specific embodiments of the present invention have been described and illustrated, it will be apparent to those skilled in the art that numerous modifications and variations can be made without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. A method, comprising:

receiving, by an interrogation portion of a network entity, a currently received signature over a wireless connection from a device;

determining, by the interrogation portion, a dynamic parameter from a clock module that emulates a corresponding clock module at the device used in generating the currently received signature;

determining, by the interrogation portion, a decryption key for the currently received signature based on the determined dynamic parameter;

decrypting, by the interrogation portion, the currently received signature to obtain a candidate identifier and a candidate scrambling code, encoded within the currently received signature, associated with the device;

consulting, by a processing portion of the network entity, a database to obtain a set of previously received scrambling codes associated with the candidate identifier, the previously received scrambling codes having been encoded in a set of previously received signatures, the set of previously received signatures associated with the candidate identifier comprising an integer number of members greater than or equal to zero; and

validating, by the processing portion, the currently received signature based on a comparison of candidate scrambling code to the set of previously received scrambling codes associated with the candidate identifier.

2. The method defined in claim **1**, wherein validating comprises determining whether the currently received scrambling code is a member of the set of previously received scrambling codes associated with the candidate identifier.

3. The method defined in claim **2**, further comprising concluding that the validating is unsuccessful when the determining indicates that the currently received scrambling code is a member of the set of previously received scrambling codes associated with the candidate identifier.

4. The method defined in claim **2**, further comprising concluding that the validating is potentially successful when the determining indicates that the currently received scrambling code is not a member of the set of previously received scrambling codes associated with the candidate identifier.

5. The method defined in claim **2**, further comprising updating the set of previously received scrambling codes associated with the candidate identifier to include the currently received scrambling code.

6. The method defined in claim **1**, wherein validating comprises determining a number of times that the currently received scrambling code has been previously received.

7. The method defined in claim **6**, further comprising concluding that the validating is unsuccessful when the determining indicates that the currently received scrambling code has been previously received more than a pre-determined number of times.

8. The method defined in claim **1**, wherein validating comprises determining how long ago the currently received scrambling code was first received.

9. The method defined in claim **8**, further comprising concluding that the validating is unsuccessful when the determining indicates that the currently received scrambling code was first received more than a pre-determined time interval ago.

10. The method defined in claim **1**, further comprising issuing a read request to the device over a contact-less channel, wherein receiving the currently received signature occurs over the contact-less channel subsequent to issuing of the read request.

11. The method defined in claim **1**, wherein the currently received signature is received over a non-secure pathway.

12. The method defined in claim **1**, wherein the non-secure pathway traverses the Internet.

13. The method defined in claim **1**, wherein when the validating is successful, the method further comprises granting access to a resource and wherein when the validating is unsuccessful, the method further comprises denying access to the resource.

14. The method defined in claim **13**, wherein the resource comprises at least one of: computing equipment, a computer network, a building, a portion of a building, an entrance, an exit and a vehicle.

15. The method defined in claim **13**, wherein the resource comprises at least one of an online resource and a financial resource.

16. The method defined, in claim **1**, wherein when the validating is successful, the method further comprises authorizing an attempted transaction and wherein when the validating is unsuccessful, the method further comprises denying the attempted transaction.

17. The method defined in claim **16**, wherein the transaction comprises a financial transaction.

18. A non-transitory computer-readable storage medium comprising computer-readable program code which, when interpreted by a computing apparatus, causes the computing apparatus to execute a method that includes:

receiving, by an interrogation portion of a network entity, a currently received signature over a wireless connection from a device;

determining, by the interrogation portion, a dynamic parameter from a clock module that emulates a corresponding clock module at the device used in generating the currently received signature;

determining, by the interrogation portion, a decryption key for the currently received signature based on the determined dynamic parameter;

decrypting, by the interrogation portion, the currently received signature to obtain a candidate identifier and a candidate scrambling code, encoded within the currently received signature, associated with the device;

consulting, by a processing portion of the network entity, a database to obtain a set of previously received scrambling codes associated with the candidate identifier, the previously received scrambling codes having been encoded in a set of previously received signatures, the set of previously received signatures associated with the candidate identifier comprising an integer number of members greater than or equal to zero; and

validating, by the processing portion, the currently received signature based on a comparison of candidate scrambling code to the set of previously received scrambling codes associated with the candidate identifier.

19. A network entity for processing signatures received from devices, the network entity configured to execute a method that includes:

receiving currently received signature from a particular device over a wireless connection; and

determining a dynamic parameter from a clock module that emulates a corresponding clock module at the device used in generating the currently received signature;

determining a decryption key for the currently received signature based on the determined dynamic parameter;

decrypting the currently received signature to obtain a candidate identifier and a candidate scrambling code, encoded within the currently received signature, associated with the particular device; and

a processing portion configured to:

consulting a database in order to obtain a set of previously received scrambling codes associated with the candidate identifier, the previously received scrambling codes having been encoded in a set of previously received signatures, the set of previously received signatures associated with the candidate identifier comprising an integer number of members greater than or equal to zero; and

validating the currently received signature based on a comparison of candidate scrambling code to the set of previously received scrambling codes associated with the candidate identifier.

20. The network entity defined in claim **19**, wherein to validate the currently received signature, the network entity is further configured to carry out a determination of whether the currently received scrambling code is a member of the set of previously received scrambling codes associated with the candidate identifier.

21. The network entity defined in claim **20**, wherein the network entity is further configured to conclude that validation of the currently received scrambling code is unsuccessful when the determination indicates that the currently received signature is a member of the set of previously received scrambling codes associated with the candidate identifier.

22. The network entity defined in claim **20**, wherein the network entity is further configured to conclude that the validation of the currently received scrambling code is potentially successful when the determination indicates that the currently received scrambling code is not a member of the set of previously received scrambling codes associated with the candidate identifier.

23. The network entity defined in claim **20**, further configured to update the set of previously received scrambling codes associated with the candidate identifier to include the currently received scrambling code.

24. The network entity defined in claim **20**, wherein the network entity is one among a plurality of network entities spatially distributed over a plurality of sites, the network entities being communicatively coupled to one another to enable the determination to be made jointly by the plurality of network entities.

25. The network entity defined in claim **19**, wherein the network entity is distributed among a plurality of spatially distributed sites.

26. The network entity defined in claim **19**, wherein the network entity is one among a plurality of network entities spatially distributed over a plurality of sites.

27. The network entity defined in claim **19**, wherein to validate the currently received scrambling code, the network entity is configured to effect a determination of a number of times that the currently received scrambling code has been previously received.

28. The network entity defined in claim **27**, wherein the network entity is further configured to conclude that validation of the currently received scrambling code is unsuccessful when the determination is indicative of the currently received scrambling code having been previously received more than a pre-determined number of times.

29. The network entity defined in claim **19**, wherein to validate the currently received scrambling code, the network entity is further configured to effect a determination of how long ago the currently received scrambling code was first received.

30. The network entity defined in claim **29**, further configured to conclude that validation of the currently received scrambling code is unsuccessful when the determination is indicative of the currently received scrambling code having been first received more than a pre-determined time interval ago.

31. The network entity defined in claim **18**, wherein when the validating is successful, the network entity is configured

to grant access to a resource and wherein when the validating is unsuccessful, the network entity is configured to deny access to the resource.

32. The network entity defined in claim **31**, wherein the resource comprises at least one of: computing equipment, a computer network, a building, a portion of a building, an entrance, an exit and a vehicle.

33. The network entity defined in claim **31**, wherein the resource comprises at least one of an online resource and a financial resource.

34. The network entity defined in claim **18**, wherein when the validating is successful, the network entity is further configured to authorize an attempted transaction and wherein when the validating is unsuccessful, the network entity is further configured to deny the attempted transaction.

35. The network entity defined in claim **34**, wherein the transaction comprises a financial transaction.

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